BERKELEY LAB

LAWRENCE BERKELEY NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

Commercial Buildings User Testbed Facility Research Capabilities

BERKELEY LAB

NOTE

The following information was presented to EETD staff and invitees at a noon-time seminar on January 12, 2012.

Please note that information provided herein is subject to change during the construction process.

For any questions, or up to date information, please contact Cindy Regnier, LBNL – CMRegnier@lbl.gov

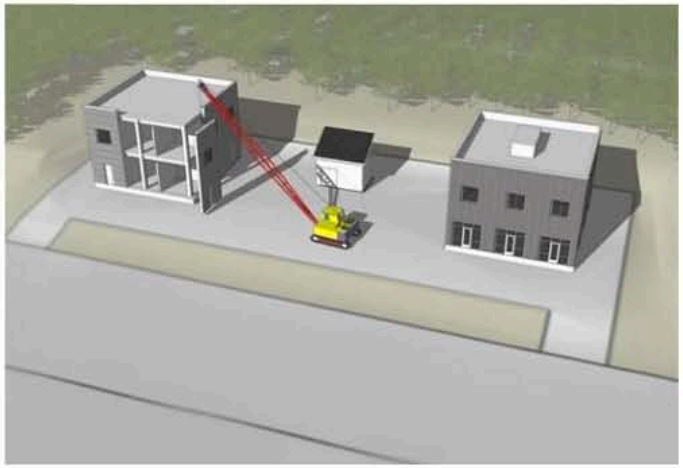
Overview

Objective: Educate EETD research staff about the facility and encourage more engagement and outreach for the project

- Update on project status
- Experimental overview
  - Sample types of experiments, deliverables, outcomes
- Facilities capabilities and functionality overview
- Management and Operations
  - Brief discussion, largely in development

General Scope

- Commercial buildings focus - Retrofit and new construction
- Focus on integrated low energy building systems (e.g. facades, shading, lighting, HVAC, MELS controls etc.)
- Exterior testbeds unoccupied or lightly occupied experiments
- ARRA funded project
- ORNL also won the lab call; their focus is on upgrading their existing facilities (focused on equipment performance mapping, envelope component testing, etc.), also constructing 2-story steel and concrete framed skeleton structures



Project Overview and Schedule

- New Construction Testbeds
  - Focus on Integrated Systems & retrofit
  - 5400 sf
  - Outside B90
  - **Opens Summer/Fall 2013**
- Occupied Lighting & Plug Load
  - ~3000 sf inside B90
  - Span width of B90
  - Controls, Visual Comfort & Behavior
  - **Opens Fall 2012**
- Controls & Visualization
  - Virtual Design & Modeling
  - Controls Interoperability
  - DR Integration
  - ~1000 sf inside B90
  - **Opens 2012-13**

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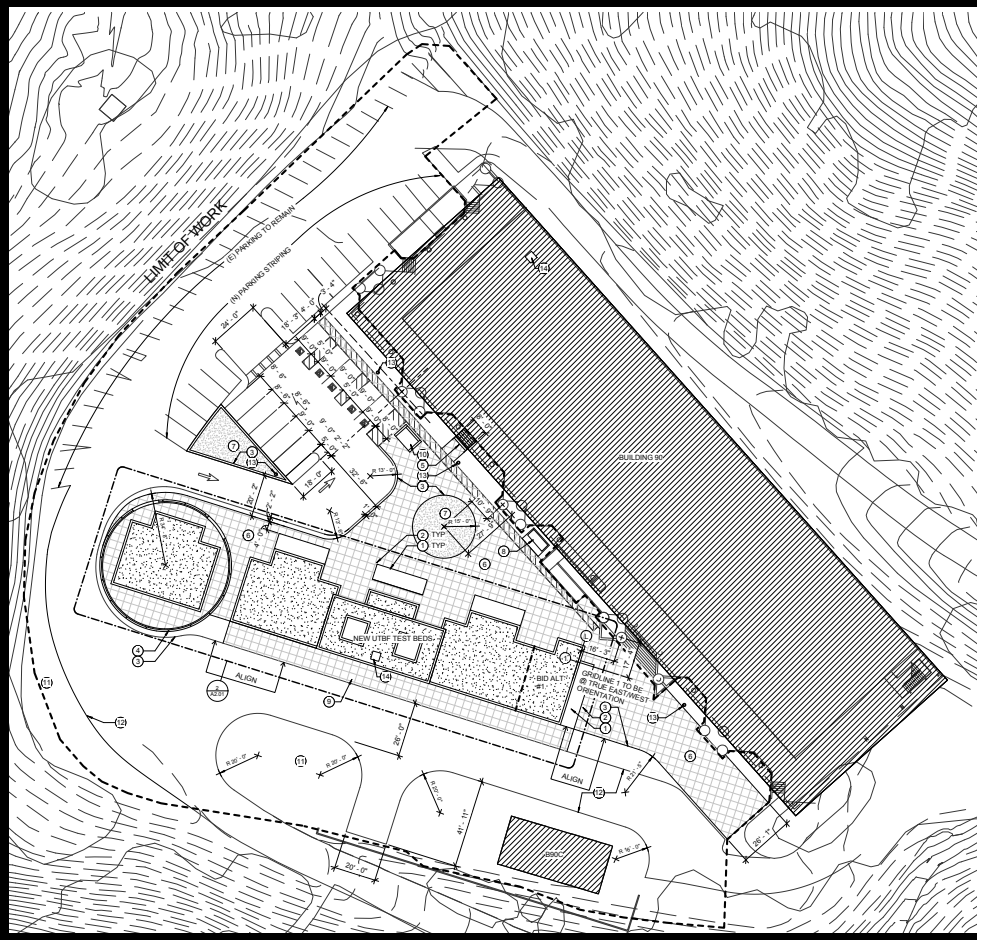
Project Status

- Bid set released Dec 2011
- Bids due end of January
- Exterior demo start Feb/Mar 2012
- Tree removal start Jan 14th

- Occupied Plug Loads and Lighting Testbed – targeted for completion <u>ready for use in FY13 SOWs</u>
- Controls Hardware Testbed – targeted for completion <u>ready for use in FY13 SOWs</u>
- New Testbeds - targeted for completion <u>ready for use in FY14 SOWs</u>

- Must have/ basic permanent infrastructure covered in budget; some scope items (e.g. add alternates, FF&E items) will be approved later in project depending on funding



Lab Call

Buildings…proposals are being solicited from the National Laboratories to construct …a facility to conduct research on the systems design, integration, and control of new and existing buildings. The new facilities to be constructed … must enable buildings science research to **holistically address the multiple interactions among buildings systems and components in order to develop integrated, high performance buildings** while improving safety, comfort, and other environmental factors.... Specifically, this facility and associated field-evaluation equipment should allow the Department to:

- **Evaluate the interactions of all component technologies, including HVAC, lighting, windows, envelope, water heating, miscellaneous equipment, control systems and renewable technologies**
- Create **the scientific and engineering foundations for designing and operating** very low energy buildings.
- Develop **new test methods and tools for use in the context of systems engineering** of very low energy buildings.
- Use these emerging test methods and tools to: Identify new solutions that lead to very low energy buildings including **new systems, components and materials**,
- Accelerate research towards achieving zero energy homes and buildings through increased focus on the systems integration of component R&D, material science and system controls

Funding will be provided to develop laboratory space and testing facility needs that allow component R&D, material science and building system controls to occur on multiple technologies concurrently and at an accelerated pace.

Experimental Potentials

Facilities to support:

- Technology development, optimization and validation (energy savings)
- Integrated systems and controls - development, optimization and validation (energy savings), e.g.:
  - Lighting/daylighting controls with automated shading;
  - HVAC controls with automated façade, operable shades, operable windows
- Validation of simulation tool algorithms
- Development of design and operational tools
- Development and validation of equipment and system performance specs
- Develop and validate Cx, M&V and auditing tools
- Two cells for comparative studies; or can be one larger cell
- Mockups for industry (manufacturers, A/E, owners, utilities for emerging tech, etc.)
- Virtual testing -> testing in facility
- Anything else you can imagine…..

Benefits to Industry

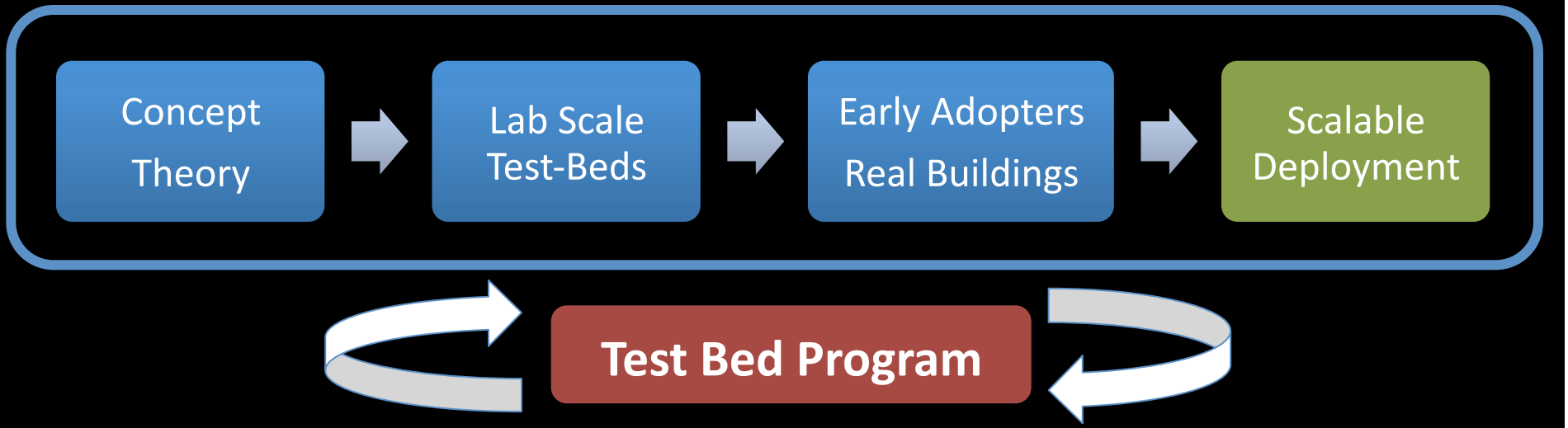
Industry: Manufacturers, A/E, owners, other research institutions, DOE, utilities, etc.

Benefits to funding and industry partners

- Well instrumented and metered facility, lowers testing cost
- Provides access to multiple flexible systems
  - Many manufacturers don't have testing facilities that can be used to integrate controls with other systems
- Highly flexible testbeds – interior and exterior assemblies
- Kits of parts available to mockup new construction and retrofit conditions

- Work with world class research staff
- Access to our knowledge base, industry overview, partner network

Deployment Strategy & Value to Industry



Architects & Engineers | Manufacturers | Investors & Entrepreneurs | Building Owners | Code Officials & Utilities | Federal State Local Government

Achieving 50% Savings at $.05/kWh CCE (DOE Ubergoal)

Current Design and Research Paradigm – Silo Approach

Single component or isolated system EEM → 5-20% Energy Savings for the Isolated component or system → $0.01 - $0.10+ CCE per EEM

Integrated Building Systems Approach

Multi-system integrated EEMs → 30-50%+ Whole Building Energy Savings → $0.01 - $0.60+ CCE for Whole Bldg

(Current cost range)

Industry and Research Examples

Single component or isolated system EEM

Lighting upgrade – fixtures and controls → 5-20% Lighting Energy Savings

Deep, multi-system integrated EEMs

New York Times – Integrated daylight dimming controls with automated shading controls → 35%+ Lighting and Cooling Energy Savings

U Hawaii at Manoa – Façade, daylighting controls, low energy lighting and plug loads, integrated natural ventilation and dehumidification controls → 50%+ Whole Building Energy Savings Over Existing Energy Use $0.50/kWh CCE

ed Energy Savings with greater
nber of integrated systems

Advances in technology and controls needed to lower cost, improve energy performance

User Facility Addresses 3 Levels of Integration - Few existing methods to address these issues

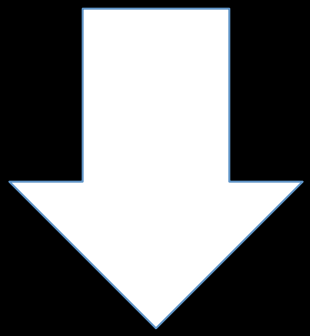
1. **Components → Systems**
   A new generation of innovative high-performance building materials and components that will be integrated into key building system, e.g., Envelope, Lighting/daylighting, HVAC, Process loads...

2. **Systems → Integrated Building Solutions**
   The integration of building systems into "whole building solutions" will demonstrate energy, demand, carbon and operating cost savings, as well as improved occupant comfort and health.

3. **Process → Measured Performance**
   The building processes and IT systems that integrate low-energy building design, construction, operations and retrofit will reliably achieve optimized performance under field conditions.

User Testbed Facility Research Agenda

- Component and Integrated System Development
- Integrated Controls Across Systems
- Integrated Design and Operational Tool Development and Validation
- Integrated Building System Solutions



- 50%+Whole Building Energy Savings
- Less Than $.05/kWh CCE

User Testbed Deliverables and Outcomes

Develop and Deploy:

- Deep, low energy integrated retrofit and design tools for all major building types based on validated
- Advanced, cost effective component, system and controls technologies
- Integrated, cross-cutting controls strategies with validated energy savings
- Develop and validate performance specifications for components and integrated systems
- Innovative tools to enable cost effective ongoing commissioning, M&V and auditing practices

Validate:

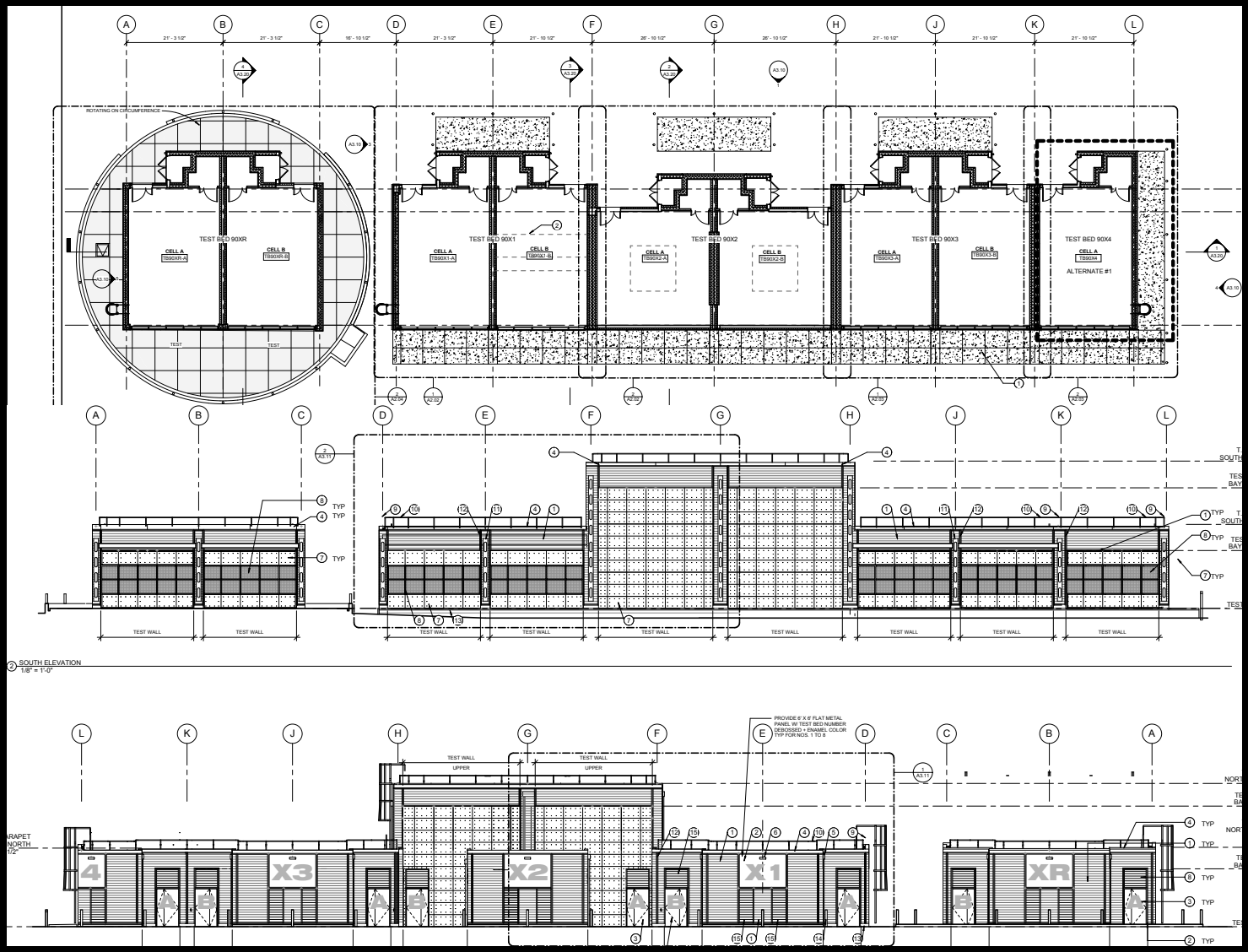
- Simulation tools to deliver case by case solutions
- Emerging technology, equipment, systems and controls for codes, standards and utility incentive development

Increased industry confidence in investment returns on efficiency technologies

Validate and assess non-energy market benefits, e.g. visual and thermal comfort, that will increase investment.

Make use of inhouse simulation tools to extend results to other climates

Facility Capabilities Overview



Facilities

BUILDING 90

- Basement Controls Hardware Testbed
- 1st Floor Virtual Design Testbed
- 1st Floor Visualization/ Education Room
- 1st Floor Operations Room
- 4th Floor Occupied Plug Loads and Lighting Testbed

NEW EXTERIOR TESTBEDS

- 4 testbeds, 2 cells each; 1 cell add alternate

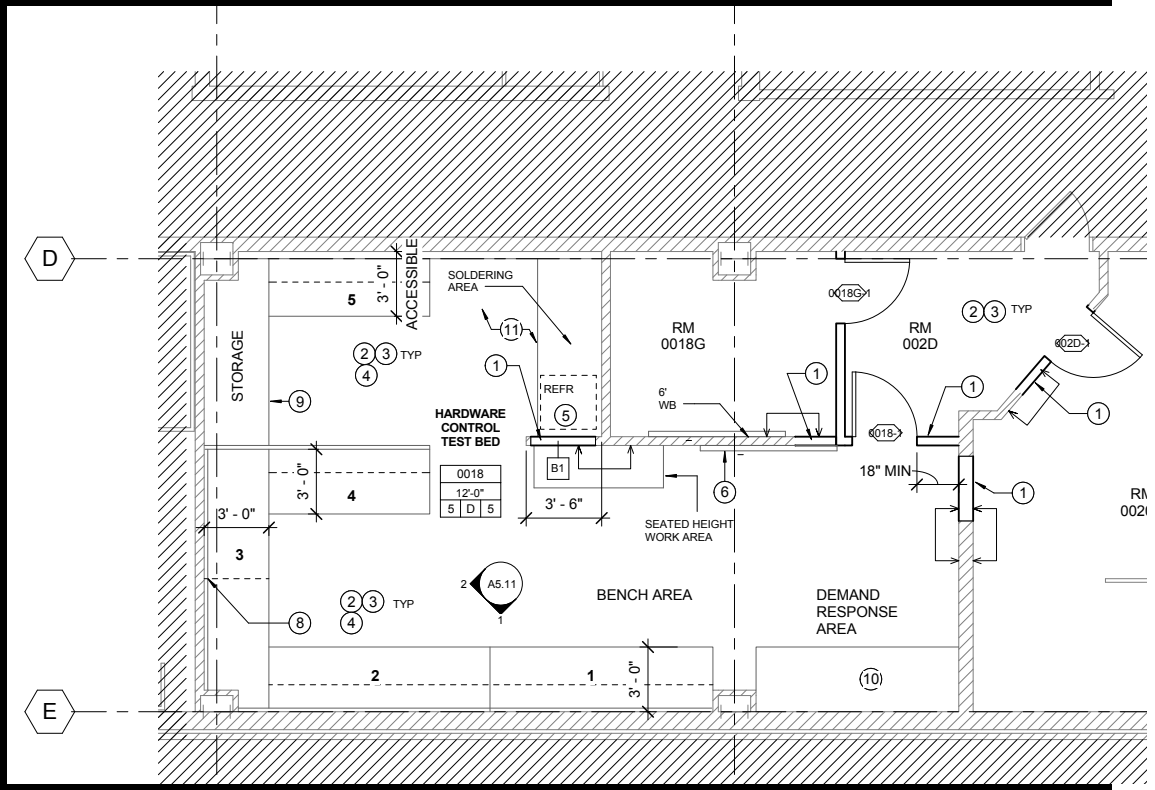
Includes:

- 1 Rotational testbed
- One high bay testbed
- Other testbeds are low bay

Facility Capabilities – Controls Hardware Testbed

Controls Hardware testbed

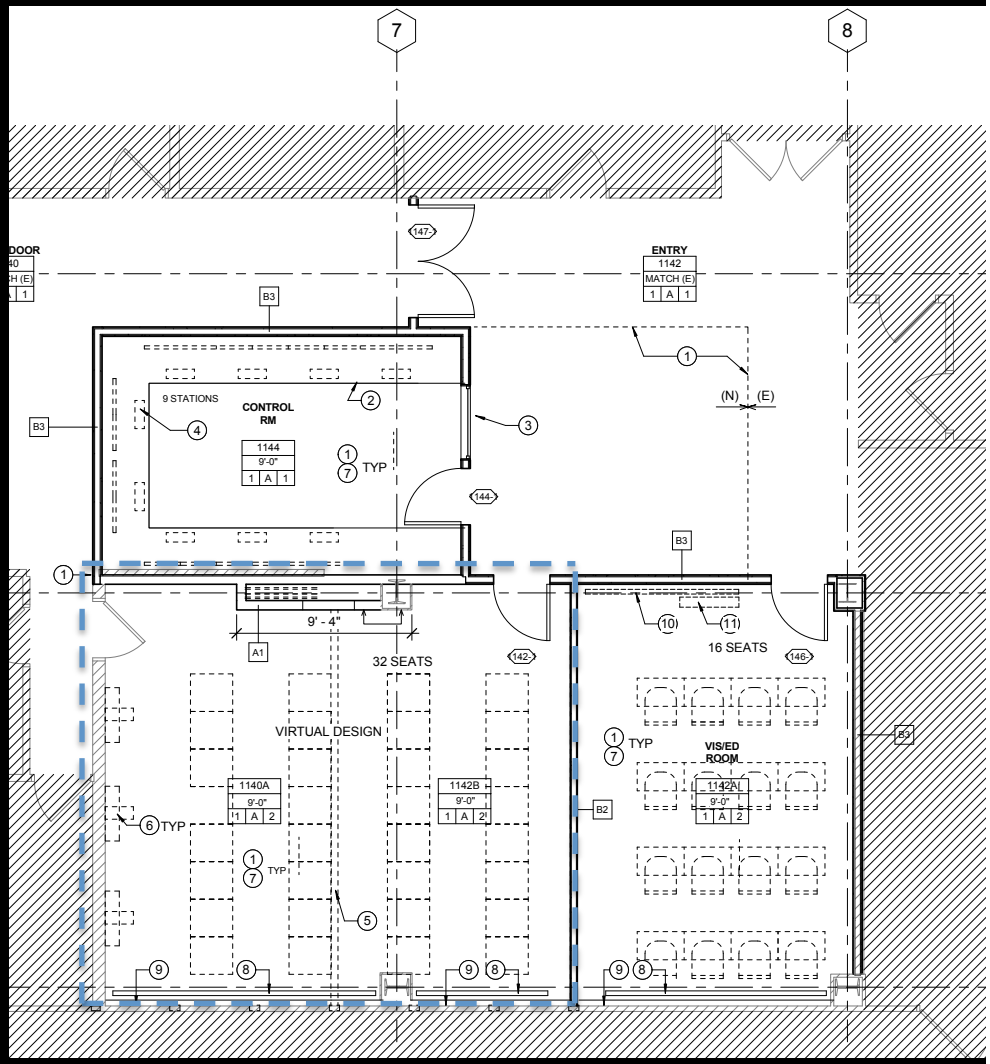
- Lab bench environment
- Soldering station
- Robust networking infrastructure
- Sensors, controls mockup and testing
- FF&E
- Demand Response area
  - Appliance and meters installed for DR testing and demonstration
  - Remote visual access via webcam for demonstration to visiting groupd (may be through Vis/Ed Room on 1st floor)



Facility Capabilities – 1st Flr Virtual Design

Virtual Design

- Two rooms separated by movable partition
- Four smartboards per room
  - Allows multiple interactive software platforms to be displayed and interact simultaneously
  - E.g. BIM, Energyplus, visualization tools, operations tools
- Teleconference capability
- Experimental scenarios:
  - BIM interoperability development and testing from design through operations
  - 'Live' design optimization
  - Operational tool development



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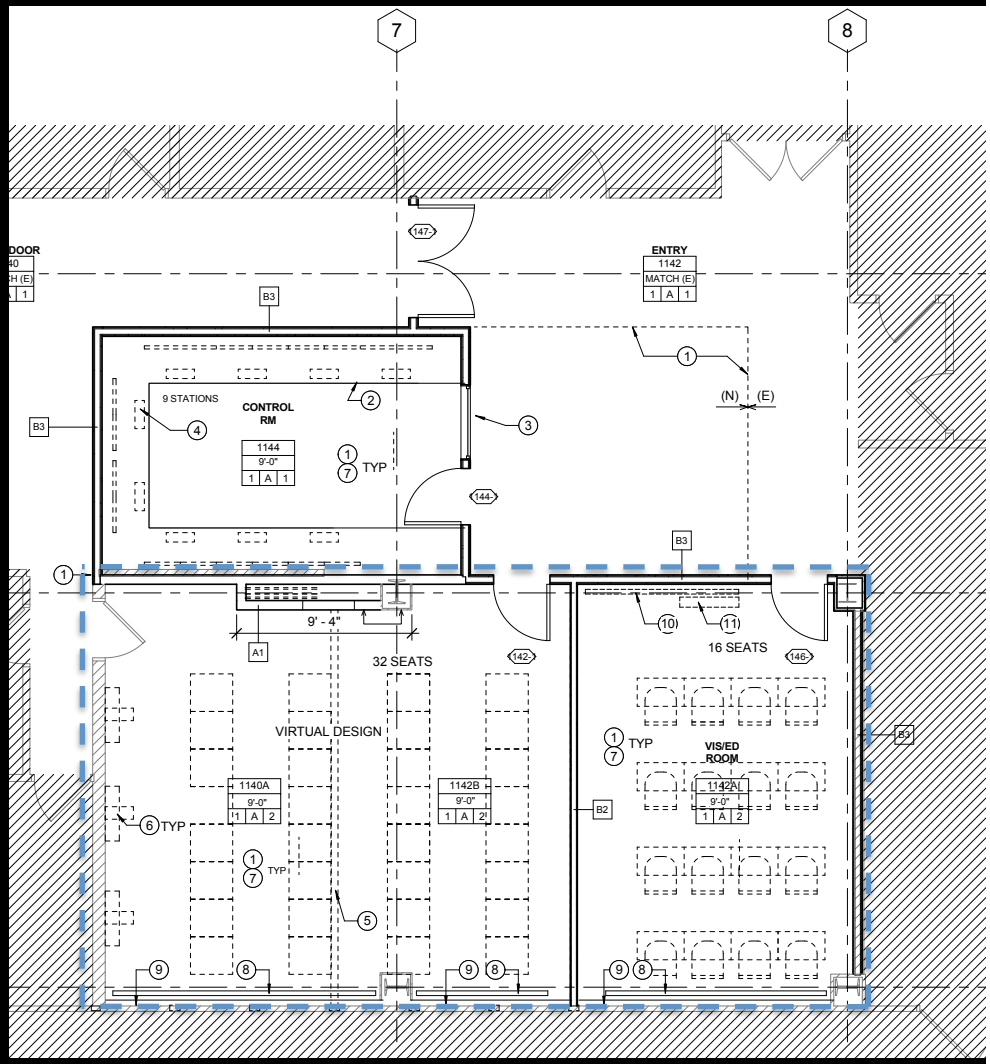
- Add alternate for third room with movable partition to enlarge to one large room



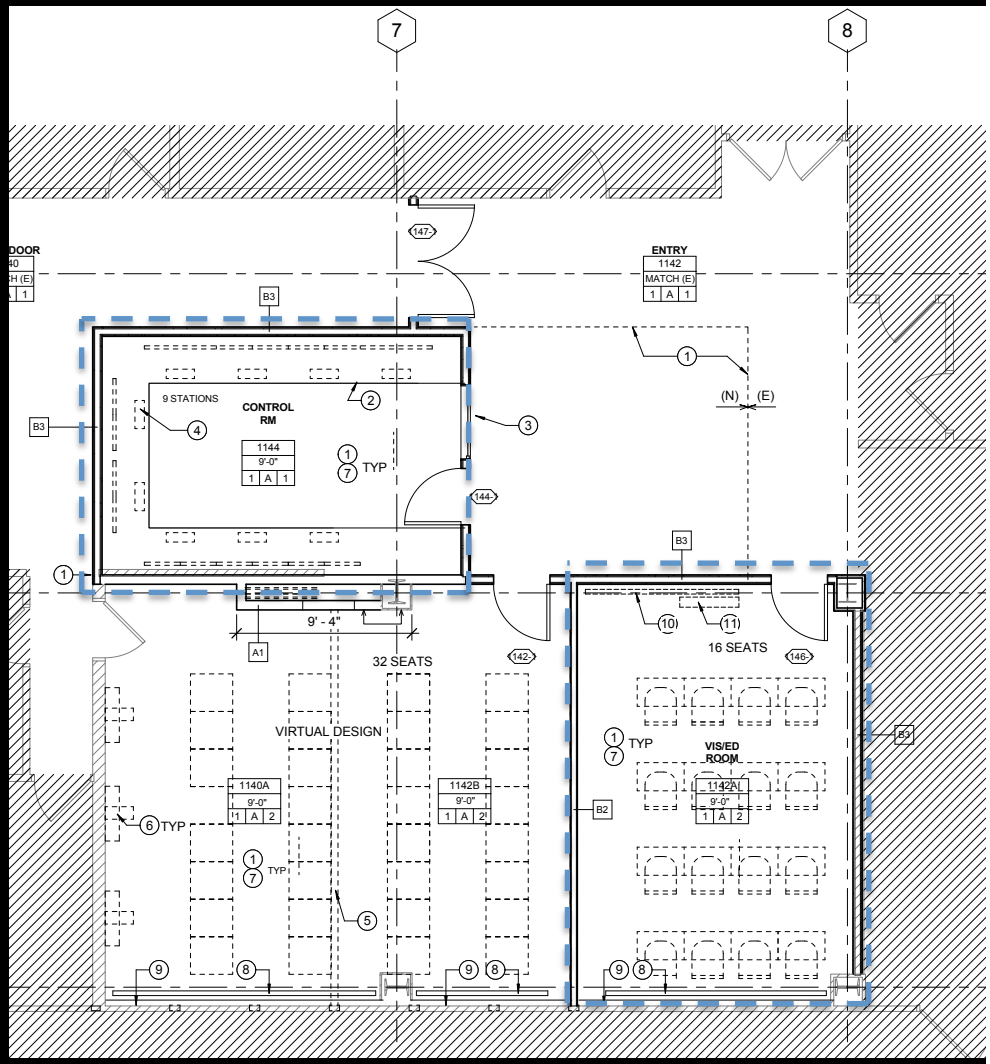
Facility Capabilities – 1st Flr Operations, Visualization/Education Rooms

Operations Room

- One workstation per cell
- Primary workstation access to controls, database and visualization of experiments at each cell

Visualization/Education Room

- Primary meeting space for testbed users
- Large scale experimental visualization capabilities for experimental review and analysis
- Demonstration site for experiments
- Teleconference capability



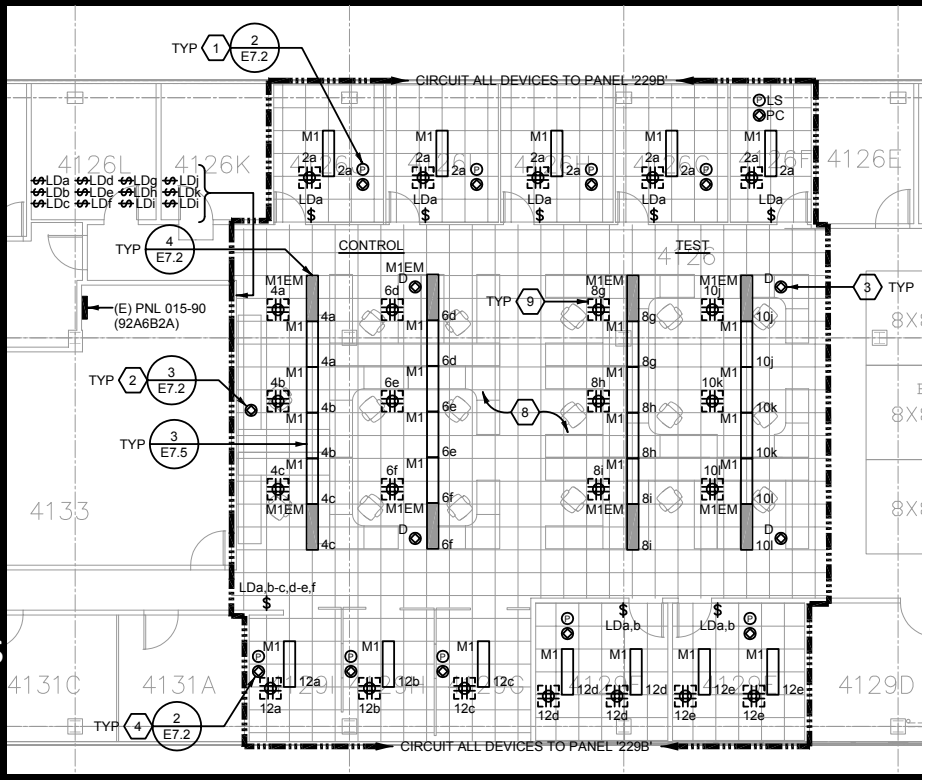
Facility Capabilities – 4th Flr Occupied Lighting and Plug Loads

<u>4flr Occupied Lighting Testbed</u>

- All work done to not interfere with occupants
- Two zones for comparative studies
- All lighting individually circuited and metered
- Programmable lighting
- Easily replaceable lighting (plug in)
- Easily replaceable lighting (plug in)
- Occupancy sensors: Computer, cube and lighting zone
- Some potential the lab might upgrade the southern facades, automated shades

Experimental uses

- Validate and assess non-energy impacts, e.g. Visual comfort
- Lighting technology and controls development, energy savings validations (e.g. occupancy based controls)
- Task lighting technologies
- Task/ambient studies
- Possible DC grid lighting studies in future



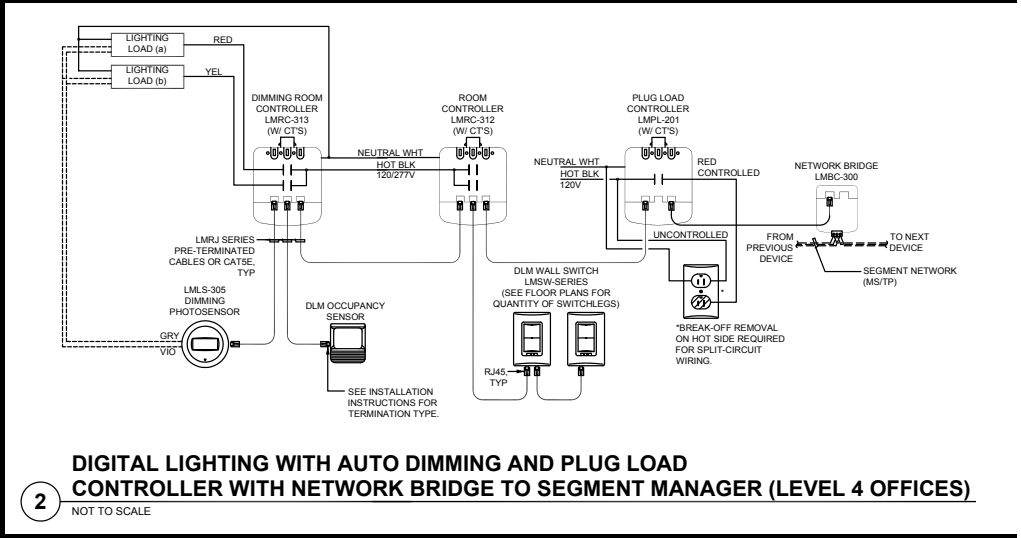
Facility Capabilities – 4th Flr Occupied Lighting and MELS

4flr Occupied MELS Testbed

- Two zones for comparative studies
- Each outlet separate circuit
- Programmable circuits
- Occupancy sensors: Computer, cube and lighting zone

Experimental uses

- MELS controls devices – development and energy savings validation
- MELS controls algorithm development
- Standby losses, power supply
- Possible DC powered technologies and controls in future



DIGITAL LIGHTING WITH AUTO DIMMING AND PLUG LOAD CONTROLLER WITH NETWORK BRIDGE TO SEGMENT MANAGER (LEVEL 4 OFFICES)

2 NOT TO SCALE

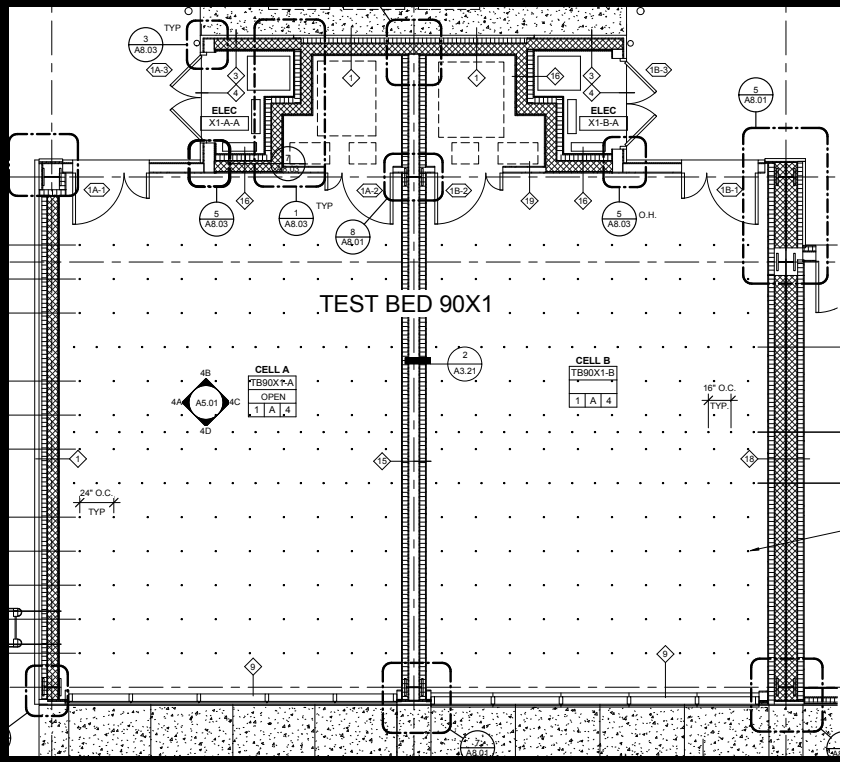
Facility Capabilities – New Testbeds

<u>Testbed Interiors</u>

- Flexible interior space, including (add alternates):
  - Variable ceiling heights to 11’-6” AFF
  - Raised floor at varying heights,
  - Interior partitions may be located to create zoning configurations
- Two cells, with removable adiabatic wall in between

Experimental uses:

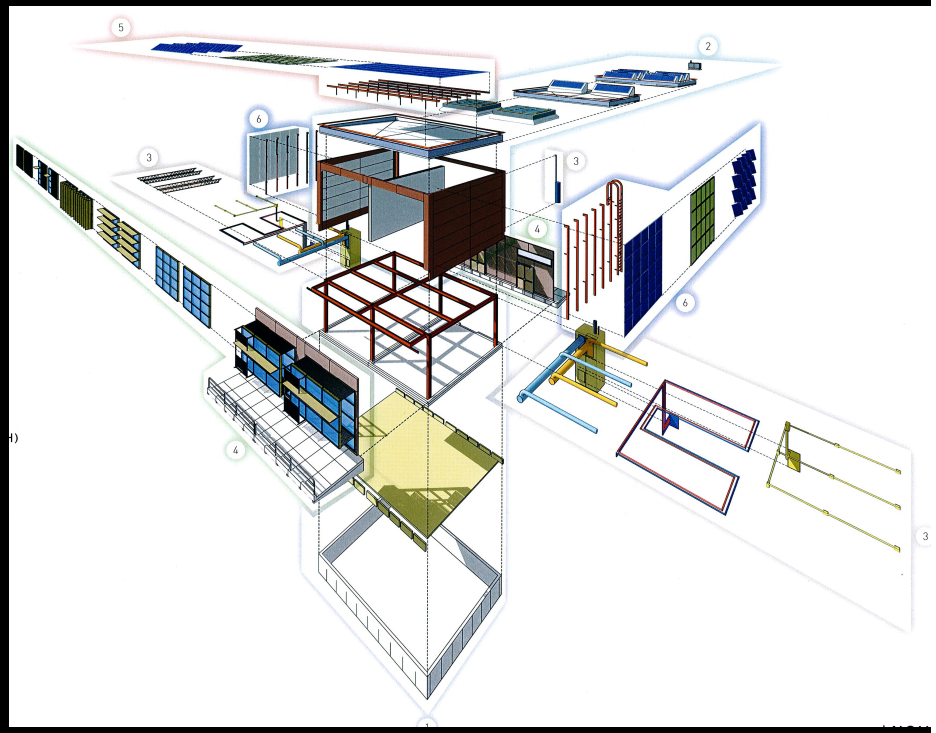
- Ability to allow for different zoning:
  - Core/perimeter
  - Up to 3 zones per cell (or more)
  - Can remove adiabatic wall between cells for larger space (40ftW x 30ftD)
- Two cells in each test bed allow <u>comparative studies</u> of systems and components



Facility Capabilities – New Testbeds

Testbed exteriors:

- Interchangeable envelope elements:
  - South façade replaceable
  - North façade
    - Not adiabatic, can be made so
    - Smaller portion replaceable, e.g. for cross ventilation studies or daylighting studies for north facing facades
  - Interior shading
  - Exterior shading
  - Opaque wall assembly
- Adiabatic East and West walls, and dividing wall between cells with thermal measurements
  - Thermally similar – no thermal bridges, SIPs
  - No concealed conduit or pipe



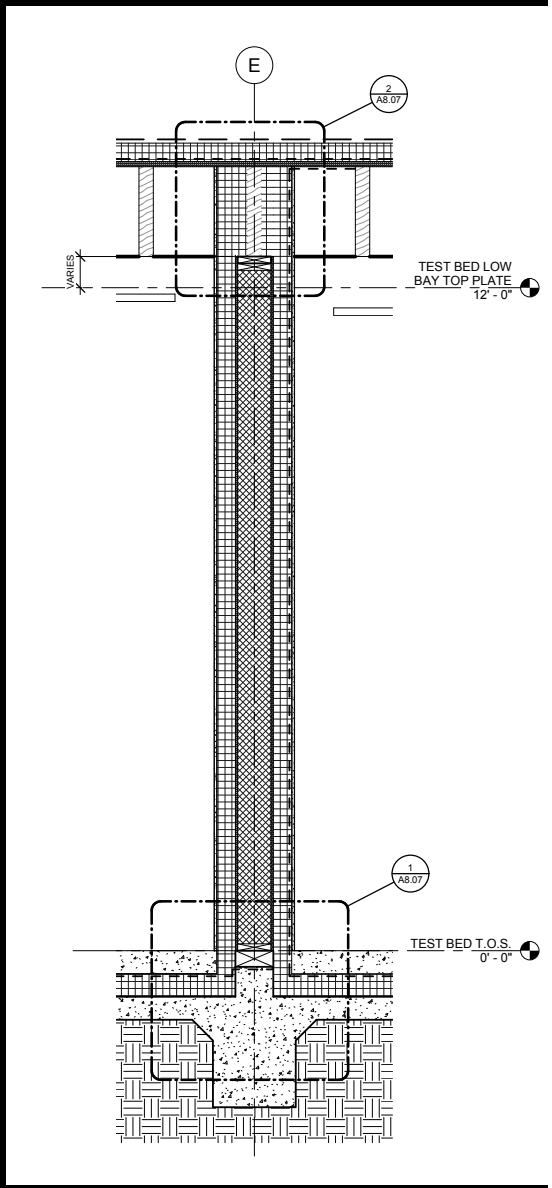
Facility Capabilities – New Testbeds

Testbed exteriors (cont'd):

- Floor thermally isolated via underslab and slab edge insulation around topping slab
- Roof
  - Not adiabatic, can add insulation above ceiling as needed
  - Cool roof membranes for most

Experimental uses:

- Permits study of high performance integrated façade systems, such as:
  - Dynamic operable shading systems with lighting and HVAC controls in space, reducing light fixture and HVAC energy use
  - Interior shading technology and controls development



Facility Capabilities – New Testbeds

HVAC

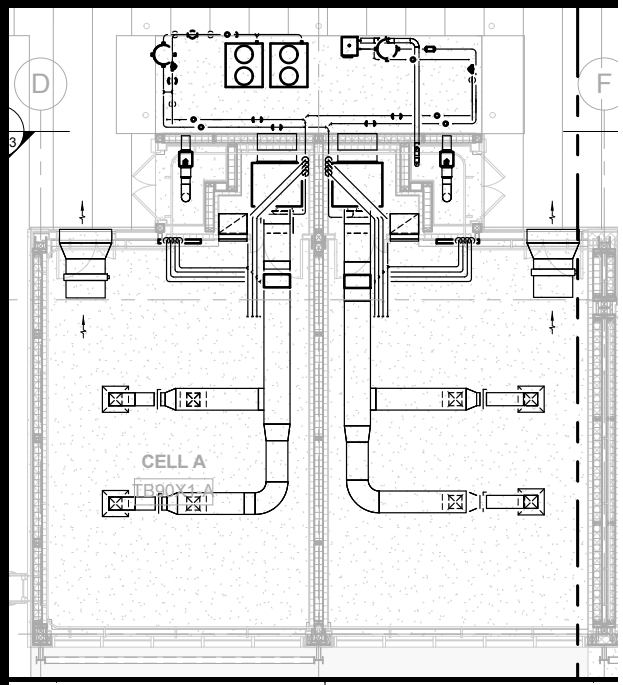
- Base system of air based conditioning – main air handler per cell
- Chilled and hot water capacity for use in alternate space conditioning systems - permits study of both air- and hydronic-based systems
- One central plant skid mounted, could be replaced with small other system – e.g. heat pumps, split system, etc.
- Limitation – not set up for larger central plant studies
- Radiant in-slab, up to 4 zones; radiant in topping slab of various thicknesses in each testbed (thermally isolated)

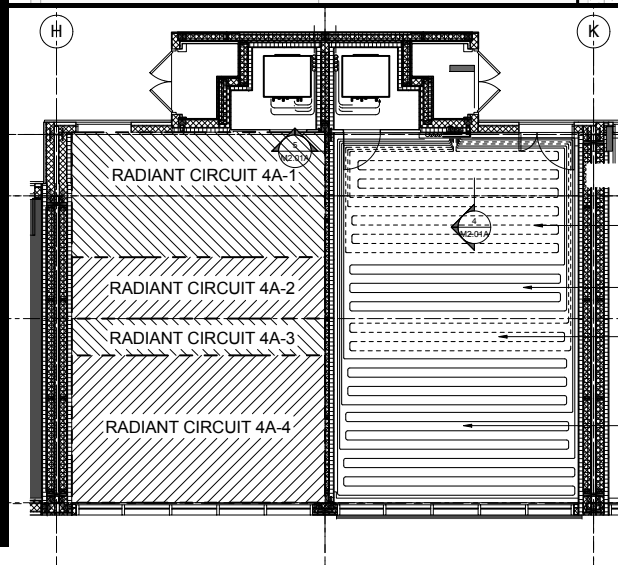
Environmental capabilities

- Two testbeds capable of simulating interior conditions much cooler or warmer than ASHRAE conditions, to simulate delta T with exterior environment similar to other climates (e.g. Denver)

Experimental uses

- Integrated technologies and controls studies for various conditioning strategies, radiant and air-based





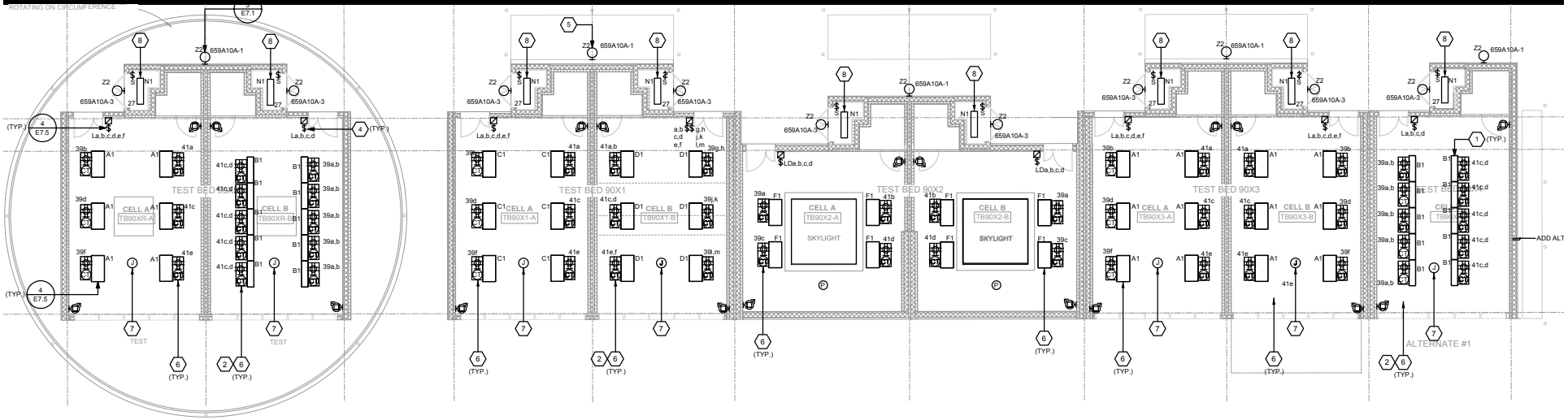
Facility Capabilities – New Testbeds

Lighting

- Easily interchangeable overhead fixtures – allows for variety of direct/indirect light fixture studies, as well as lighting designs that emphasize daylighting controls, and task lighting applications
- Plug in fixtures, each outlet

Experimental uses

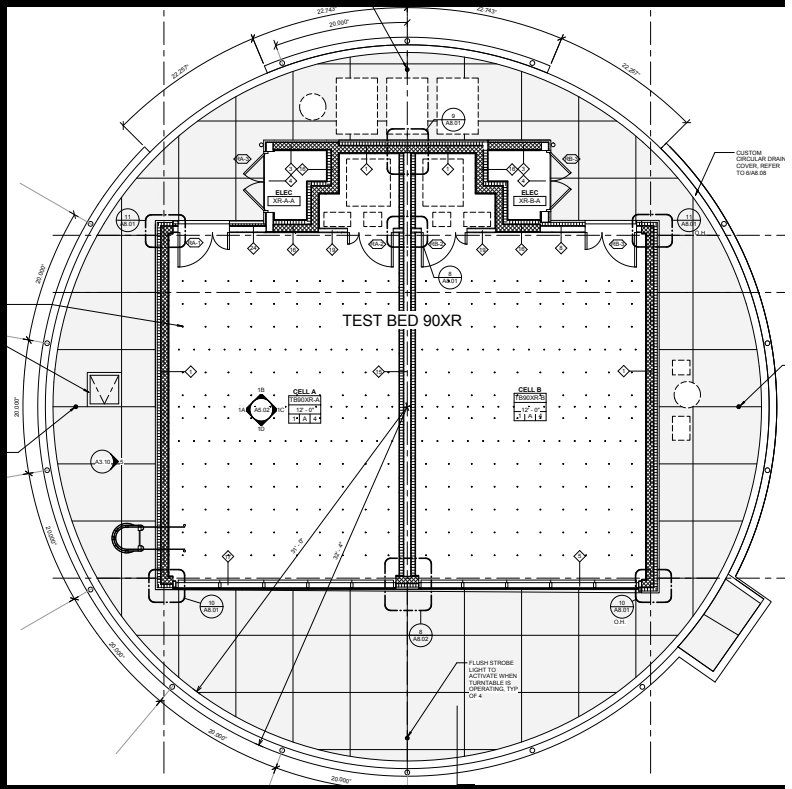
- Lighting technology and controls development and validation
- Integrated daylighting studies with facades, interior shading, etc.



Facility Capabilities – Rotational Testbed

Facilities

- Similar testbed configuration to other low bay testbeds; same ceiling, facades, HVAC, lighting, plug loads interchangeability
- Capable to reset position every minute to align with sun orientation
- Can be used to reposition to other orientations for static testing



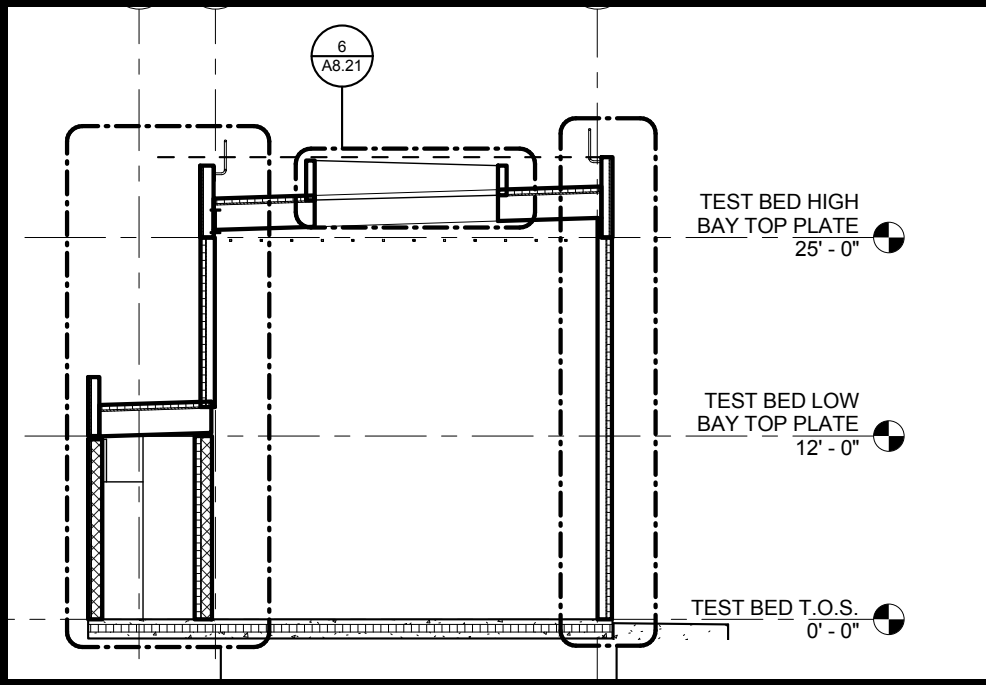
Experimental uses

- Facades and daylighting studies with solar tracking
- Facades, daylighting, technology and controls development for non-south orientations (e.g. challenging western exposure)

Facility Capabilities – High Bay Testbed

Facilities

- Reconfigurable skylights and clerestories
- Cube layout – 25ftWx25ftDx25ftH for equidistant surfaces for daylighting measurements
- Potential for installation of interstitial floor for 2-story applications in future
- Double height replaceable southern facade



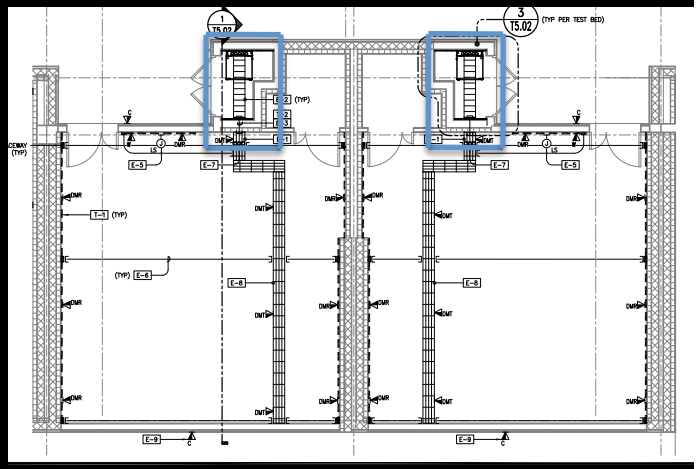
Experimental uses

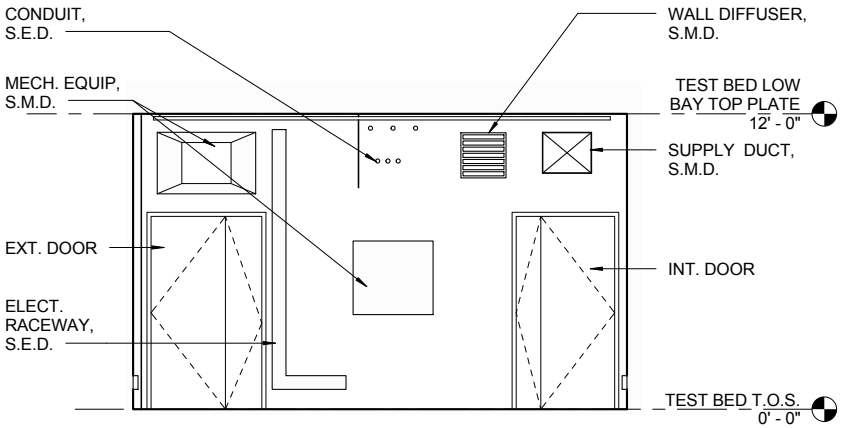
- Technology and controls development, e.g. automated operable clerestories; skylight technologies
- Double skin facades studies
- Zonal studies involving multi-story buildings

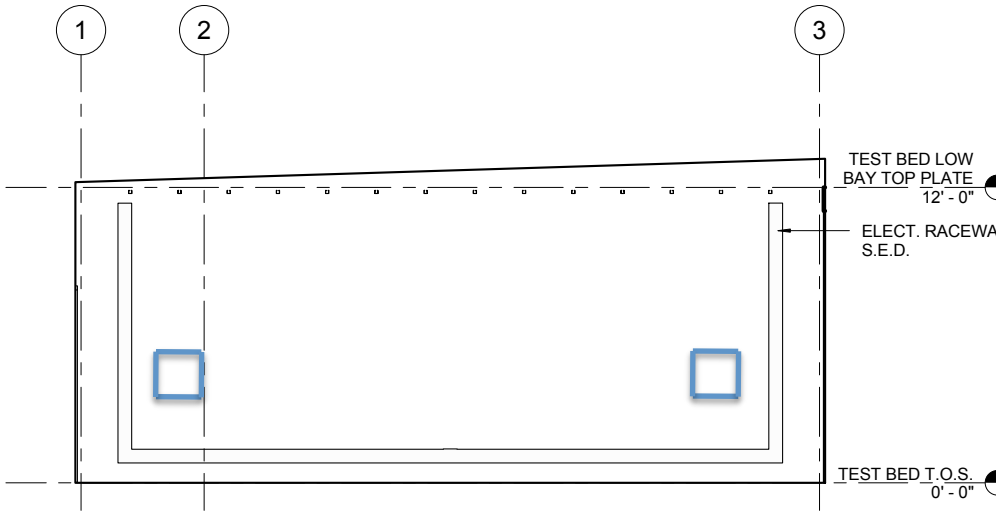
Facility Capabilities – Data Acquisition System and Controls

DAQ Hardware

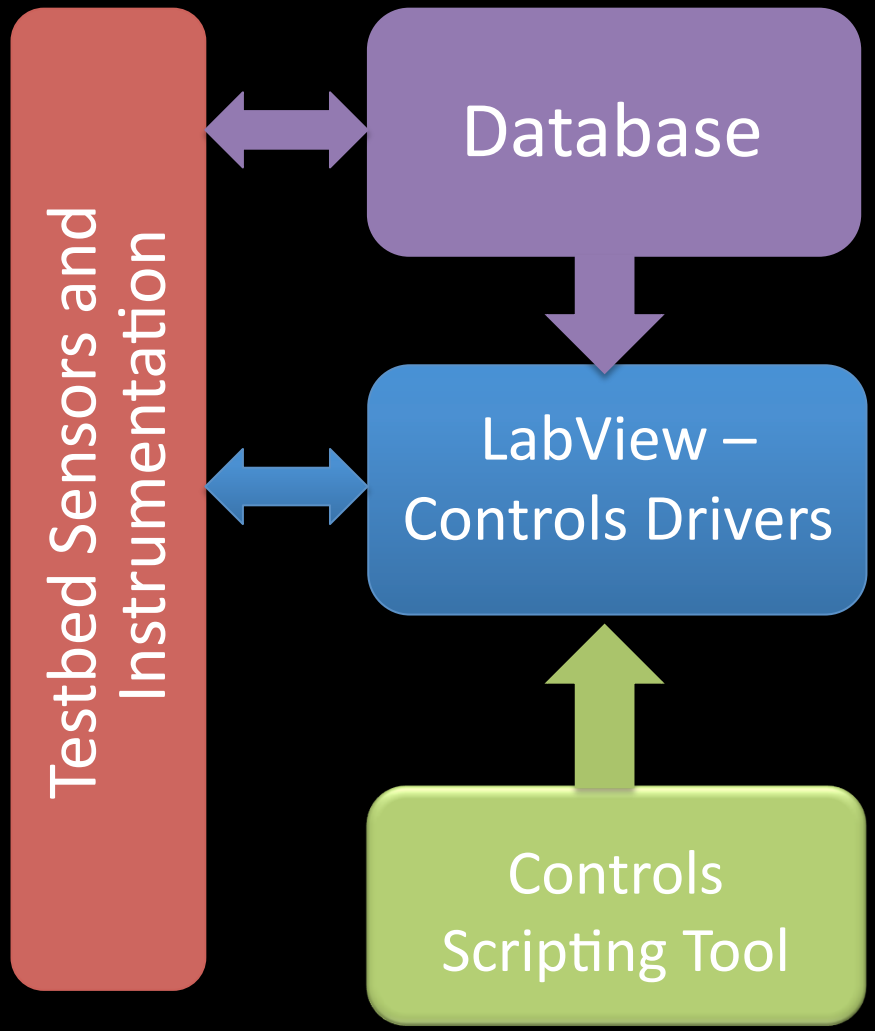
- Local DAQ server per cell
- Patch panels for experimental I/O
  - 4 per cell
- Ethernet and power raceway available in each cell for sensors, instrumentation and equipment
- Telecomm rack local to each cell
  - DAQ server
  - DAQ I/O card chassis
  - Rack space for POE injectors (future)
  - Wireless router







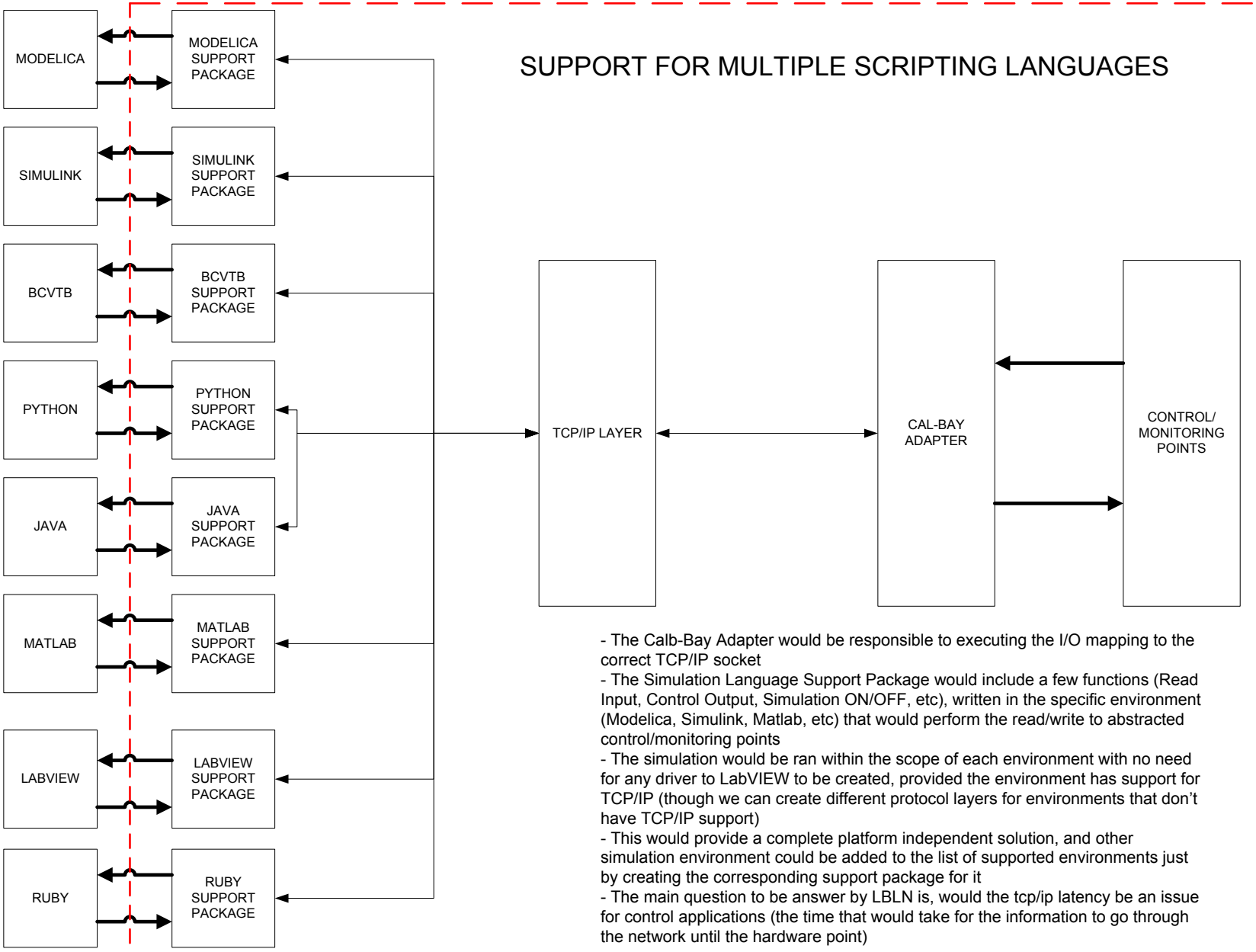
Data Acquisition and Controls Infrastructure



DAQ and Controls Software

- Central database, secure database partition per cell
- Monitoring and Visualization package
- Controls Scripting tool
  - LabView based
  - Base HVAC controls
  - One platform for providing other controls sequences, e.g. Lighting, automated shades, etc.
  - A few standard calc packages available (e.g. psych calcs – brought in from EnergyPlus)
- Controls access either onsite or remotely
- Adapter package to allow controls interface with different simulation and controls platforms

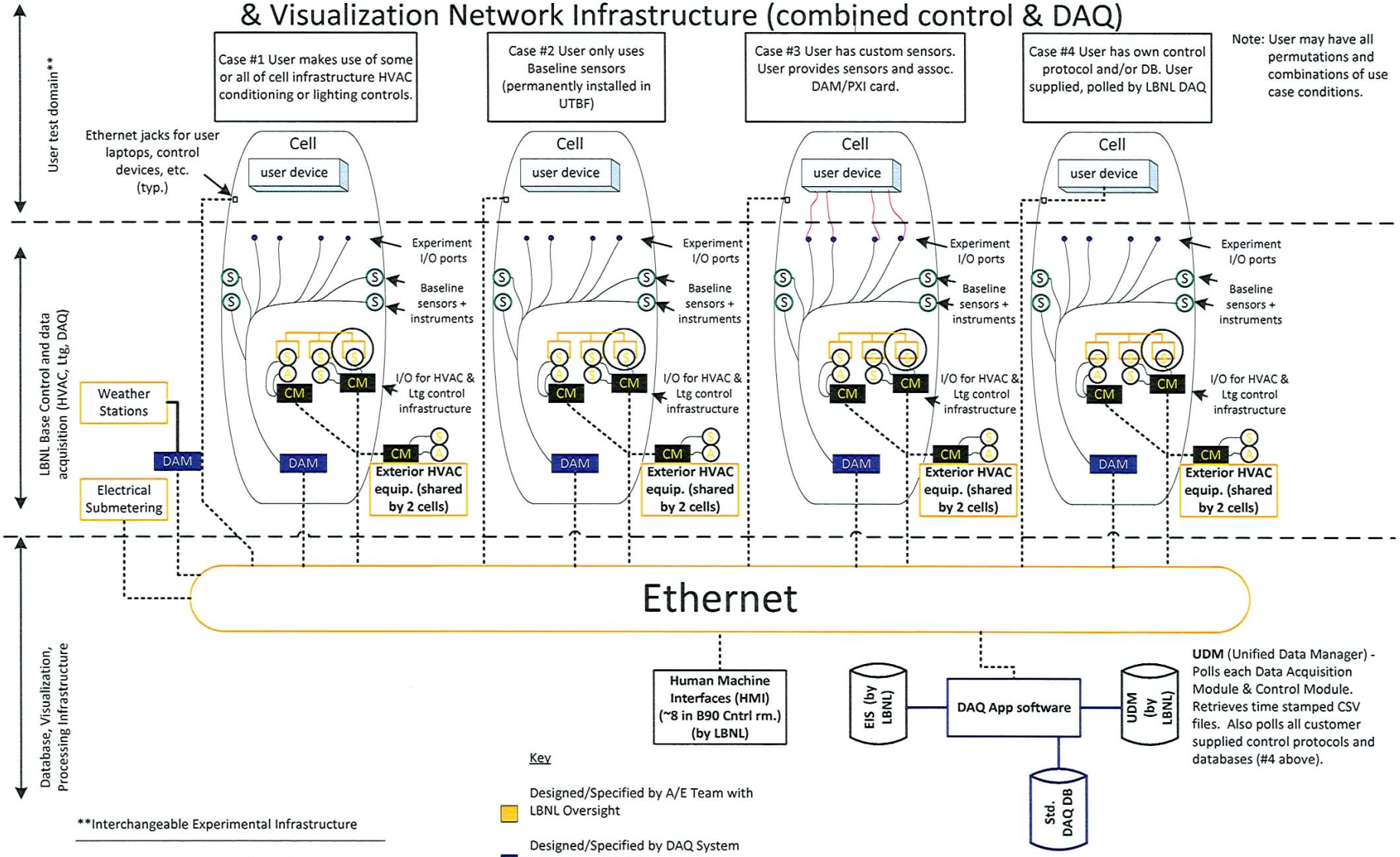
SUPPORT FOR MULTIPLE SCRIPTING LANGUAGES



- The Calb-Bay Adapter would be responsible to executing the I/O mapping to the correct TCP/IP socket
- The Simulation Language Support Package would include a few functions (Read Input, Control Output, Simulation ON/OFF, etc), written in the specific environment (Modelica, Simulink, Matlab, etc) that would perform the read/write to abstracted control/monitoring points
- The simulation would be ran within the scope of each environment with no need for any driver to LabVIEW to be created, provided the environment has support for TCP/IP (though we can create different protocol layers for environments that don't have TCP/IP support)
- This would provide a complete platform independent solution, and other simulation environment could be added to the list of supported environments just by creating the corresponding support package for it
- The main question to be answer by LBLN is, would the tcp/ip latency be an issue for control applications (the time that would take for the information to go through the network until the hardware point)

USER TESTBED FACILITY – Controls, Data Acquisition & Visualization Network Infrastructure (combined control & DAQ)

LBNL, D.W. + C. R. , 5/10/2011 v3



**Interchangeable Experimental Infrastructure

Allows Flexible Controls Platforms & Components, e.g.

- Stand-Alone Lighting Controllers & Controls
- Stand-Alone Shading Controllers & Controls
- Stand-Alone HVAC or EMS Platforms, Controllers & Controls (e.g. Siemens, ALC, etc.)
- Localized Laptop, Labview or Building Controls Virtual Testbed
- Localized Database, if Needed

Facility Capabilities – Instrumentation

‘Base’ instrumentation, lots of granularity

- Weather station
  - Global and diffuse horizontal illuminance
  - Global and diffuse horizontal irradiance
  - Outside air RH, DB
  - HDR camera with automated solar shadow
- Power metering
  - HVAC, lighting, MELS broken out at panel level
  - Individual CTs on each circuit, currently typically one device per circuit
  - One circuit per outlet in testbed
- Flow metering
  - Mag flows with temp sensors at each cell, chilled and hot water
  - Bypass calibration meter
- Other base instrumentation:
  - Occupancy sensors, air supply flow measurement, room pressure, lighting and glare measurements
  - Slab edge heat flux
  - Thermal sensors at ‘adiabatic’ walls and areas of thermal bridging concern

‘Experimental’ instrumentation

- Additional sensors and instrumentation brought in as needed by experiment
- Various connections to DAQ and controls available

Facility Capabilities – Instrumentation
Weather Station

Testbed Baseline Sensors and Instrumentation Set

Tesbeds 1-4 (New Construction Testbeds)

	Item	Qty	Location	Specs
1	Weather Station	1	One at test bed row	
	Global and diffuse horizontal illuminance	1 (Incl. in weather station) - Provide dedicated DAQ channel	At southwestern most corner of testbed 2A/B (high bay). Mount on platform at appropriate height for cleaning and maintenance (2 - 4 ft suggested).	Pyronometer w/shadow band and automated tracker. Delta-T Devices Sunshine Pyranometer SPN1. Accuracy - PAR = +- 12%, Energy = +-12%, Illuminance (+-12%)
	Global and diffuse horizontal irradiance	1 (Incl. in weather station) - Provide dedicated DAQ channel	At southwestern most corner of testbed 2A/B (high bay). Mount on platform at appropriate height for cleaning and maintenance (2 - 4 ft suggested).	Delta-T Devices Sunshine Sensor BF5. Accuracy - PAR = +- 12%, Energy = +-12%, Illuminance (+-12%)
	Outside air RH	1 (Incl. in weather station) - Provide dedicated DAQ channel	At rear of testbed 1A/B adjacent to HVAC air intakes. To be installed at a height of between 4 and 6 feet in an enclosure that provides a shield against direct solar radiation and supports natural air flow. Easy access required for calibration and maintenance purposes.	Chilled mirror w/thermionic heat pump, GE Optisonde. Temp accuracy = +-0.15°C, dew/frost accuracy = +-0.2°C.
	Outside air DB temp	1 (Incl. in weather station) - Provide dedicated DAQ channel	At rear of testbed 1A/B adjacent to HVAC air intakes. To be installed at a height of between 4 and 6 feet in an enclosure that provides a shield against direct solar radiation and supports natural air flow. Easy access required for calibration and maintenance purposes.	Calibrated accuracy =+-0.1°C
	HDR camera with automated solar shadow	2 (Incl. in weather station) - Provide dedicated DAQ channel	At southwestern most corner of the testbed 2A/B (high bay).	Place next to pyranometer in tracker, or get a second tracker (less preferable due to shading). 2 HDR cameras (one east facing, one west) for vertical surface measurements OR (less preferable) 8 vertical illuminance sensors (4 global and 4 shielded to see sky only), mounted in the four cardinal directions.

Facility Capabilities – Instrumentation

9	Thermal comfort sensing package	6	connected to DAQ raceway when needed.	accuracy = +-0.2°C.
10	Interior occupancy sensor	9	1 per test bed cell, centrally located	Infrared and ultrasonic occupancy sensor, mounted at underside of ceiling with 5ft of flexible cable, located in center of room; omnidirectional.
11	Interior stratification trees for temperature measurement, DB	1 tree with 12 sensors	Not permanently installed, will be connected to DAQ raceway when needed.	Relocatable tree with 12-16 points with fast response sensors (thermistors), located within ~6-10 ft from each other. Wireless sensors preferred. All tree sensors to be shielded. Calibrated accuracy = +- 0.1 °C. Consider network data bus devices rather than multiple channels to centralized multipliers.
13	Hot water flow meters	9	One per cell at hot water line serving cell.	Variable metering to allow for very low and very high flow measurements to same level of accuracy. Overall Btu meter accuracy = +-1% of reading >20-1 turndown. Platinum turbine flowmeters piped in full size bypass for calibration.
14	Hot water supply and return temperature sensors	18	Two per cell at hot water line serving cell.	Selected to ensure Btu meter accuracy listed, but no lower accuracy than 0.15°F matching differential between two sensors. Accuracy = +-0.05°F. Sealed temperature wells that accept stainless PRT probes for accuracy, stability and ease of recalibration. High stability thermistors as back-up redundancy, same accuracy.
15	Chilled water flow meters	9	One per cell at chilled water line serving cell.	Variable metering to allow for very low and very high flow measurements to same level of accuracy. Overall Btu meter accuracy = +-1% of reading >20-1 turndown. Platinum turbine flowmeters piped in full size bypass for calibration.
16	Chilled water supply and return temperature sensors	18	Two per cell at chilled water line serving cell.	Selected to ensure Btu meter accuracy listed, but no lower accuracy than 0.15°F matching differential between two sensors. High stability thermistors, accuracy = +-0.05°F. Sealed temperature wells that accept stainless PRT probes for accuracy, stability and ease of recalibration. High stability thermistors as back-up redundancy, same accuracy.
17	Power metering	See Location	All internal loads independently, overhead lighting, task lighting, fan powered terminal units, computers, and simulated people, and control and DAQ power if within the cell. Current transducers on each luminaire. Power measurements on individual components of heating and cooling systems.	Accuracy = 1% of reading.
18	Air supply airflow measurement	9	One per cell. For installation on cell-dedicated air handling units.	Variable metering to allow for very low and very high flow measurements to same level of accuracy. Accuracy =-1% of reading.
19	Room pressure measurement	9 (See Location)	One per cell. See also spec.	Pressure: Room, supply plenum absolute and deltaP. Accuracy = 0.25% full scale or better. DG700 pressure sensors from The Energy Conservancy with auto-zero ability.
21	Occupant thermal generator	6	Not permanently installed, will be connected to DAQ raceway when needed.	
22	Exterior light levels instrumentation package	1	Covered in the weather station	Covered in the weather station
23	Slab edge heat flux sensors	36 (See Location)	Structural slab outside of isolated topping slab, one for each side of the topping slab.	Sensitivity: 500uV/Wm2, Accuracy within +/-0.1%. Indicative specification: Hukseflux HFP03.
24	Thermal bridging RH sensors	18 (See Location)	First main area - at corner colums of testbed rows, and at columns at ends of walls between testbeds and cells. Second main main area - at center of any wall separating testbeds or cells that is a double wall assembly with an air gap between.	Calibrated accuracy = +/- 5% RH. Indicative specification: Vailsala HMT311 HUMICAP
25	Thermal bridging heat tape	18 (See Location)	First main area - at corner colums of testbed rows, and at columns at ends of walls between testbeds and cells. Second main main area - at center of any wall separating testbeds or cells that is a double wall assembly with an air gap between.	Adhesive heating tape for localized heating of thermal bridging infrastructure, principally steel I-beam columns.
26	Lighting Measurement	20	10 LICOR units per cell for two cells.	LICOR 210 - accuracy = +- 5%
27	Glare Measurement	8 plus 1 alternate	1 Canon 5D Camera unit per cell.	Canon EOS 5D Digital Camera with SIGMA lens - accuracy = +-10%. Data recording and storage to AppleMac mini desktop.
28	Glare Measurement	4 plus 1 alternate	Data recording and storage to AppleMac mini desktop, 1 per two testbed cells.	AppleMac Mini with gPhoto capability.

Facility Capabilities – First Fit Outs

First fitouts of testbeds – south façade, and interior lighting:

- 1980s (1 testbed) – retrofit condition
- 90.1-2010 (3 cells)
- Title 24 2013 (3 cells)
- Net zero (1 cell)

- HVAC terminal systems – add alternates
  - Includes VAV reheat, fan coil, displacement ventilation, underfloor ventilation, chilled beams, radiant panels

- Kit of façade and HVAC 'parts' to interchange to some other configurations (e.g. more 90.1-2010 south façade available)

Management and Operations

Currently not funded for management or operations by DOE
Discussions with DOE to restore M&O planning funding
We have run facilities in the past (e.g. 71T) for years with success without operations support funding
Experiments will likely follow the following tracks:

- DOE funded research
- Utility funded (e.g. ETCC, PG&E etc.)
- CRADA, cost-share with industry partner
- Proprietary funded with industry partner

Safety

- Design reviewed
- Anchors on roof
- Platform ladders short testbeds, scaffold tall testbed

Envelope switchouts

- Use of contractor

Sample Cost Share Scenarios

	Different Experiment Types - Cost Share Models		
Cost Type	DOE Core Program Research	CRADA	User Funded Proprietary Research
Configuration	100%	50%	0%
Safety	100%	50%	0%
Calibration	100%	50%	0%
Fixed Admin Labor	100%	100%	100%
	Funded by DOE	DOE Cost share with User	User pays for all direct costs

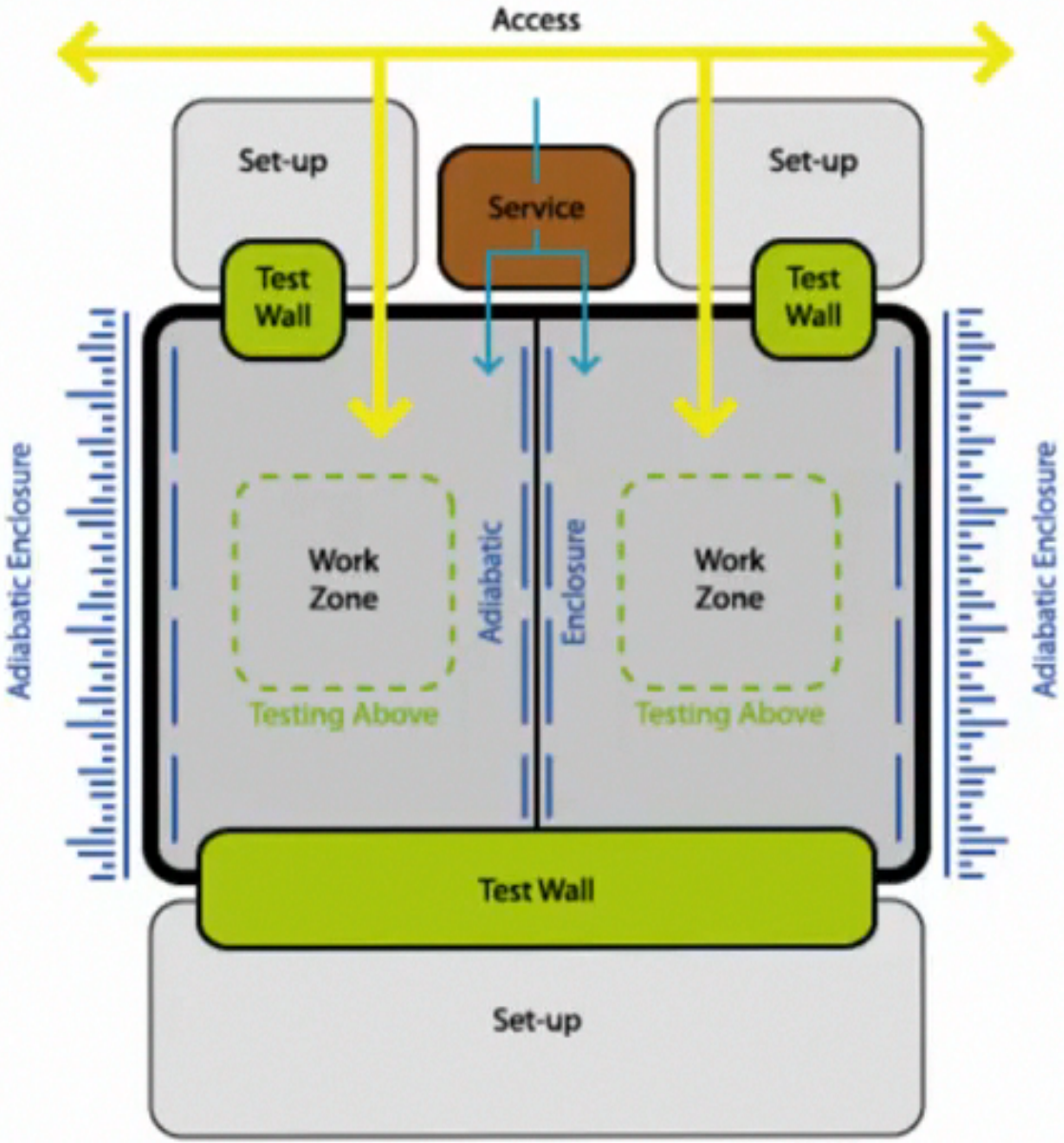
Sample Experimental Partners

Facility Capability	Integrated Systems and Controls Devel.	Technology Development	Technology Validation
Sample Partner	**Philips**	**Daikin**	**State of California**
Objective	Rapid-prototyping platform for controls development; combined lighting and HVAC savings	Optimize efficiency of variable refrig flow systems with human behavior system modifications	Validate energy savings of emerging systems and tech. for codes, standards & incentives
Market Impact	Improved controls that optimize lighting, shading and HVAC (Approx 50% savings)	Increased HVAC energy savings technology and controls	Increased adoption and deployment of technologies (10-50%+ savings)
Benefits over existing resources	Unprecedented - lighting controls typ. not integrated	Ability to iterate through multiple installation scenarios	Many technologies currently unvetted and less used

Management and Operations

FY12 M&O Planning Activities

1. Industry partnership development
   a. Program development and launch
   b. Develop partner selection & evaluation methods
   c. Establish co-funded collaborations
2. Business systems & operating resources
3. Safe and efficient operations development
4. Strategic planning
5. Collaboration with other test facilities



Test Bed Diagam

Getting Engaged

- Marketing materials with sample experiment use cases will be available in time for those going to ASHRAE (see Oren Schetrit, Steve Selkowitz or myself)
- Materials will be available on 3rd floor near elevator

- Think of the User Facility as a resource when engaging with any visitors to the lab; please put us in contact with interested parties
- Reach out to industry partners for experiments; keep us informed

- Remember Building 90 interior testbeds are targeted for completion by end of FY12; consider for use in FY13 funding proposals

- Any questions or further information:
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  - Oren Schetrit, OSchetrit@lbl.gov

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